

FORM RTO-1390  
(REV 10/95)

U. S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

ATTORNEY'S DOCKET NUMBER

HUBR 1165 (10023593)

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR 1.5)

09/647207

**TRANSMITTAL LETTER TO THE UNITED STATES  
DESIGNATED/ELECTED OFFICE (DO/EO/US)  
CONCERNING A FILING UNDER 35 U.S.C. 371**

INTERNATIONAL APPLICATION NO. PCT/EP99/02238	INTERNATIONAL FILING DATE 1 April 1999	PRIORITY DATE CLAIMED 7 April 1998
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**TITLE OF INVENTION**

ADHESIVE-FREE POLYMER COMPONENT JOINTS FOR PRODUCING CLOSED MICRO- AND NANO-CHANNEL STRUCTURES

**APPLICANT(S) FOR DO/EO/US**

Michael STUKE, et al.

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1.  This is the FIRST submission of items concerning a filing under 35 U.S.C. 371.
2.  This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371.
3.  This express request to begin national examination procedures (35 U.S.C. 371(f) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(l)).
4.  A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5.  A copy of the International Application as filed (35 U.S.C. 371(c)(2))
  - a.  is transmitted herewith (required only if not transmitted by the International Bureau.)
  - b.  has been transmitted by the International Bureau.
  - c.  is not required, as the application was filed in the United States Receiving Office (RO/US).
6.  A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7.  Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
  - a.  are transmitted herewith (required only if not transmitted by the International Bureau).
  - b.  have been transmitted by the International Bureau.
  - c.  have not been made; however, the time limit for making such amendments has NOT expired.
  - d.  have not been made and will not be made.
8.  A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9.  An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10.  A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

**Items 11. to 16. below concern document(s) or information included:**

11.  An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12.  An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13.  A FIRST preliminary amendment.
  - A SECOND or SUBSEQUENT preliminary amendment.
14.  A substitute specification.
15.  A change of power of attorney and/or address letter.
16.  Other items or information: Small Entity Statement
17.  The follow fees are submitted
18.  PCT/RO/101; PCT/IPEA/416

CALCULATIONS

pto use only

**BASIC NATIONAL FEE (37 CFR 1.492(A)(1) - (5)):**

09/647207

Search Report has been prepared by the EPO or JPO .....	\$840.00
International preliminary examination fee paid to USPTO (37 CFR 1.482) .....	<u>430 Rec'd PCT/PTO</u>
.....	\$680.00
No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)) .....	\$750.00
Neither International preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO .....	\$1010.00
International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) .....	\$94.00

27 SEP 2000

**ENTER APPROPRIATE BASIC FEE AMOUNT =**

\$420.00

Surcharge of \$130.00 for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input checked="" type="checkbox"/> 30	\$ 65.00
months from the earliest claimed priority date (37 CFR 1.492(e)).	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	
Total claims	22	- 20 = 2	x \$22.00	\$ 44.00
Independent claims		- 3 = 0	x \$78.00	\$ 0

MULTIPLE DEPENDENT CLAIM(S) (if applicable)	+ \$250.00	\$
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**TOTAL OF ABOVE CALCULATIONS =**

\$0

Reduction of ½ for filing by small entity, if applicable. Verified Small Entity Statement must also be filed (Note 37 CFR 1.9, 1.27, 1.28).	\$1,014.00
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**SUBTOTAL =**

\$507

Processing fee of \$130.00 for furnishing the English translation later than <input type="checkbox"/> 20 <input checked="" type="checkbox"/> 30	\$
months from the earliest claimed priority date (37 CFR 1.492(f)).	+

**TOTAL NATIONAL FEE =**

\$

Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property	\$
+	

**TOTAL FEES ENCLOSED =**

\$507.00

<b>Amount to be: refunded</b>	\$
<b>charged</b>	\$

- a.  A check in the amount of \$ 507.00 to cover the above fees is enclosed.
- b.  Please charge my Deposit Account No. \_\_\_\_\_ in the amount of \$ \_\_\_\_\_ to cover the above fees.  
A duplicate copy of this sheet is enclosed.
- c.  The Commissioner is hereby authorized to charge any fees which may be required, or credit any overpayment to Deposit Account No. 500624. A duplicate copy of this sheet is enclosed.

**NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.**

SEND ALL CORRESPONDENCE TO

  
 SIGNATURE

David Rubin  
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 40,314  
 REGISTRATION NUMBER

09/647207  
430 Rec'd PCT/PTO 27 SEP 2000

HUBR 1165

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s) : Stuke et al.  
International Appln. No. : PCT/EP99/02238  
Filed : Herewith  
For : ADHESIVE-FREE POLYMER COMPONENT JOINTS FOR PRODUCING CLOSED MICRO- AND NANO-CHANNEL STRUCTURES

Hon. Commissioner of Patents  
and Trademarks  
Washington, D.C. 20231

September 26, 2000

**PRELIMINARY AMENDMENT**

SIR:

Prior to examination, please amend the application as follows:

**IN THE CLAIMS**

Please cancel pending claims 1-22.

Please add the following claims 23-44, as follows:

23. A process for the adhesive-free production of polymeric components, including the steps of:

(a) preparing a polymeric substrate which, on at least one surface, has depressions forming micro- and/or nanochannel structures,

- (b) applying, by uniform pressure extending over the surface, a polymeric covering to a surface present on the substrate, said substrate having depressions but otherwise being smooth,
- (c) slowly heating the substrate, with the covering applied by pressure, to a temperature which is at least as high as the glass transition temperature of the substrate and/or of the covering, for the bonding thereof, and
- (d) cooling.

24. The process as claimed in claim 23, wherein  
the polymeric substrate and the polymeric covering are selected from the group consisting of acrylic polymers, polycarbonates, polystyrenes, and also copolymers and mixtures of these.
25. The process as claimed in claim 24, wherein  
the polymeric substrate and the polymeric covering are selected from the group consisting of acrylic polymers, in particular of polymethyl methacrylate polymers, or of polymeric carbonates.
26. The process as claimed in claim 23, wherein  
the substrate has depressions with a width or/and depth within the range from 10 nm to 2 mm.
27. The process as claimed in claim 26, wherein

the substrate has depressions with a width or/and depth within the range from 100 nm to 1 mm.

28. The process as claimed in claim 27, wherein

the substrate has depressions with a width or/and depth within the range from 1  $\mu\text{m}$  to 500  $\mu\text{m}$ .

29. The process as claimed in claim 23, wherein

substrate and covering are selected from among polymeric materials of the same type.

30. The process as claimed in claim 23, wherein

at least the covering is selected from among optically transparent materials.

31. The process as claimed in claim 23, wherein

the polymeric covering and the substrate are combined by pressure.

32. The process as claimed in claim 31, wherein

the pressure applied is within the range from 1 to 1000 kg/cm<sup>2</sup>.

33. The process as claimed in claim 23, wherein

the duration of heating is within the range from 0.5 to 3 h.

34. The process as claimed in claim 23, wherein

the heating temperature is not more than 5 °C above the glass transition temperature.

35. The process as claimed in claim 23, wherein

the substrate and the covering present thereupon are held within the region of the heating temperature for a period of at least 15 min.

36. The process as claimed in claim 35, wherein  
the substrate and covering present thereupon are held within the region of the heating  
temperature for a period of at least 30 min.
37. The process as claimed in claim 35, wherein  
the holding temperature is within  $\pm 3$  °C of the heating temperature.
38. The process is claimed in claim 23, wherein  
the duration of the cooling is at least 1 h.
39. The process as claimed in claim 38, wherein  
the duration of the cooling is at least 2 h.
40. The process as claimed in claim 23, wherein  
the duration of the cooling is up to 30 sec.
41. A polymeric constituent with hollow structures present therein, obtainable by a  
process as claimed in claim 23.
42. A polymeric component as claimed in claim 41, wherein  
the hollow structures comprise closed channels with a width or/and depth of from 10  
nm to 10 mm.
43. A polymeric component as claimed in claim 41, wherein  
the interior of the component is free from adhesives.
44. The use of polymeric components as claimed in claim 41 in detection procedures, in  
particular in optical or/and electrical detection procedures.

## REMARKS

This application is a national stage filing under 35 U.S.C. § 371 of PCT/EP99/02238.

Support for new claims 23-44 is found in the English-language translation of the specification, in the English-language translation of originally filed claims 1-22, and in the translation of the annex to the International Preliminary Examination Report. Applicants request entry of the foregoing amendments.

A check in the amount of \$507.00 is included with this filing to cover the basic national fee, and the fee for two additional claims over 20 claims. Fees have been reduced by half, reflecting applicant's small entity statement. A small entity statement is filed herewith. The Commissioner is hereby authorized to deduct any additional fees associated with this filing from, or credit any overpayment to Deposit Account No. 500624.

Respectfully submitted,

FULBRIGHT & JAWORSKI L.L.P.

By   
\_\_\_\_\_  
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Applicant or Patentee: Stuke et al.Attorney's HUBR 1165  
Docket No.: \_\_\_\_\_

Serial or Patent No.: \_\_\_\_\_

Filed or Issued: \_\_\_\_\_

For: ADHESIVE-FREE POLYMER COMPONENT JOINTS FOR PRODUCING CLOSED MICRO- AND NANO...  
VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY STATUS  
(37 CFR 1.9(f) and 1.27 (d) - NONPROFIT ORGANIZATION

I hereby declare that I am an official empowered to act on behalf of the nonprofit organization identified below:

NAME OF ORGANIZATION Max-Planck-Gesellschaft zur Förderung der Wissenschaften e.V.  
ADDRESS OF ORGANIZATION Hofgartenstraße 8  
80539 München, Germany

## TYPE OF ORGANIZATION

- UNIVERSITY OR OTHER INSTITUTION OF HIGHER EDUCATION  
 TAX EXEMPT UNDER INTERNAL REVENUE SERVICE CODE (26 USC 501(a) and 501 (c) (3))  
 NONPROFIT SCIENTIFIC OR EDUCATIONAL UNDER STATUTE OF STATE OF THE UNITED STATES OF AMERICA  
 (NAME OF STATE \_\_\_\_\_)  
 (CITATION OF STATUTE \_\_\_\_\_)  
 WOULD QUALIFY AS TAX EXEMPT UNDER INTERNAL REVENUE SERVICE CODE  
 (26 USC 501(a) AND 501(c) (3) IF LOCATED IN THE UNITED STATES OF AMERICA  
 WOULD QUALIFY AS NONPROFIT SCIENTIFIC OR EDUCATIONAL UNDER STATUTE  
 OF THE UNITED STATES OF AMERICA IF LOCATED IN THE UNITED STATES OF AMERICA  
 (NAME OF STATE \_\_\_\_\_)  
 (CITATION OF STATUTE \_\_\_\_\_)

I hereby declare that the nonprofit organization identified above qualifies as a nonprofit organization as defined in 37 CFR 1.9(e) for purposes of paying reduced fees under section 41(a) and (b) of Title 35, United States Code with regard to the invention entitled \_\_\_\_\_ by inventor(s) Michael Stuke;

in Markus Lapczyna; Kurt Müller described

- the specification filed herewith  
 application serial no. \_\_\_\_\_, filed \_\_\_\_\_  
 patent no. \_\_\_\_\_, issued \_\_\_\_\_

I hereby declare that rights under contract or law have been conveyed to and remain with the nonprofit organization with regard to the above identified invention. If the rights held by the nonprofit organization are not exclusive, each individual, concern or organization having rights to the invention is listed below \* and no rights to the invention are held by any person, other than the inventor, who could not qualify as small business concern under 37 CFR 1.9 (d) or by any concern which would not qualify as a small business concern under 37 CFR 1.9 (d) or a nonprofit organization under 37 CFR 1.9(e). \*  
 NOTE: Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities.  
 (37 CFR 1.27)

NAME \_\_\_\_\_  
ADDRESS \_\_\_\_\_

- INDIVIDUAL  SMALL BUSINESS CONCERN  NONPROFIT ORGANIZATION

NAME \_\_\_\_\_  
ADDRESS \_\_\_\_\_

- INDIVIDUAL  SMALL BUSINESS CONCERN  NONPROFIT ORGANIZATION

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate (37 CFR 1.28(b))

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

NAME OF PERSON SIGNING Christa Herzog  
TITLE IN ORGANIZATION Head of patent department  
ADDRESS OF PERSON SIGNING Hofgartenstr. 8, 80539 München  
SIGNATURE Christa Herzog

Max-Planck-Gesellschaft zur Förderung der Wissenschaften e.V.

09/647207

4337351 PCT/PTO 27 SEP 2000

WO 99/51422

PCT/EP99/02238

Adhesive-free bonding of polymeric components to produce closed micro- and nanochannel structures

Description

5

The invention relates to a process for producing polymeric components with hollow structures present therein, e.g. in the form of closed micro- or/and nanochannels, said process using no adhesives. The 10 invention further relates to the polymeric parts obtainable by the process and to their use in detection procedures.

15 Polymeric components, e.g. plastic biochips, in the interior of which closed hollow structures are present have hitherto been produced by a process in which an adhesive, e.g. a UV-curable adhesive, has been used to bond a plastic outer layer onto a plastic substrate in which depressions are present. However, the use of the 20 adhesive has led to considerable disadvantages. For example, if too much adhesive was applied, capillary interactions caused it to migrate into the channels and render these impassable, at least to some extent. On the other hand, if too little adhesive was used dead 25 spaces were produced directly adjacent to the channels. The process was moreover highly inconvenient, since operations had to be carried out under a microscope. Finally, the presence of the adhesive also impaired the 30 chemical or/and spectroscopic properties of the plastic component.

DE-A-40 22 793 has disclosed that a heated welding tool can be used to weld a polymeric film onto a sheet of polymer in which recesses are present, without prior 35 heating of the sheet of polymer or the polymeric film. The pressure of the welding tool produces a grid of point welds. The welding tool is heated to a temperature of from 250 to 300°C (column 4, lines 63-65), and therefore chemical modification of the

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polymeric materials can occur, combined with possible reduction in transparency and/or increase in base-level fluorescence. In addition, undesirable dead spaces are produced adjacent to the welds.

5

The object on which the present invention is based was therefore to provide a process for producing polymeric or plastic components provided with hollow structures, said process at least to some extent avoiding the 10 abovementioned disadvantages of the prior art.

This object is achieved by a process for producing polymeric constituents, including the steps of:

- (a) preparing a polymeric substrate which has depressions on at least one surface,
- (b) applying a polymeric covering to a surface present on the substrate and having depressions,
- (c) heating the substrate with the covering present thereupon to a temperature which is at least as high as the glass transition temperature of the substrate or/and of the covering, and
- (d) cooling.

Step (a) of the novel process comprises preparing a 25 polymeric substrate with open depressions on a surface. A covering is applied to this surface with the aim of producing a polymeric component with hollow structures closed on their upward-facing sides. The polymeric substrates and polymeric coverings used for this 30 purpose are selected from the class consisting of melt-processable thermoplastics, preferably from the class consisting of acrylic polymers, polycarbonates, polystyrenes, and also copolymers and mixtures of these. It is preferably for polymeric substrates and 35 polymeric covering to be selected from among acrylic polymers, such as polyacrylate, polymethacrylate and in particular polymethyl methacrylate polymers or polycarbonates.

- 3 -

The polymeric substrate has depressions on at least one surface. These depressions preferably have a width or/and depth within the range from 10 nm to 2 mm, particularly preferably from 100 nm to 1 mm and most 5 preferably from 1  $\mu\text{m}$  to 500  $\mu\text{m}$ . The depressions preferably comprise structures in the form of channels.

Using the process according to the invention, a polymeric covering, for example a polymeric film, is 10 laminated onto this substrate without using adhesives. For this, substrate and covering are preferably selected from among polymeric materials of similar type, in particular from the same polymeric materials. It is moreover preferable for at least the covering and 15 in particular both the covering and the substrate to be composed of optically transparent materials, i.e. materials transparent within the visible or/and UV light regions.

20 To produce the substrate with a surface having depressions, a contact mask may first be produced, namely by using a laser to etch the desired microstructures into a silicon membrane under chlorine gas. This contact mask is then laid on the plastic 25 substrate and irradiated with laser light, e.g. with a UV vacuum laser, whereupon ablation cuts the desired channels into the plastic. The depth of cut may be set precisely via the laser and is, for example, 100 nm per irradiation. The resultant channels have a very smooth 30 surface. Removal of the mask then gives the polymeric substrate which can be used for the process according to the invention. As an alternative, the substrates provided with open microstructures may also be produced from a master mold, e.g. by injection molding.

35

Step (b) of the process according to the invention comprises the application of a polymeric covering onto one or more surfaces present on the substrate and having depressions. For this, the surface of the

- 4 -

polymeric covering, which may also be a film, for example, and the surface of the substrate are prepared in a form which is clean and as smooth as possible. The covering is then preferably positioned on the substrate 5 and the two parts combined by pressure, the pressure applied being preferably within the range from 0.1 to 1000 kg/cm<sup>2</sup>, e.g. from 0.2 to 20 kg/cm<sup>2</sup>.

Then, in step (c) of the process according to the 10 invention, the substrate, with the covering present thereupon, is heated to a temperature which is at least as high as the glass transition temperature of the substrate or/and of the covering. The heating preferably takes place in a controllable heating 15 cabinet, proceeding slowly from the initial temperature (e.g. room temperature) to a value just above the glass transition temperature of one of the polymers. The glass transition temperature depends on the heating rate and can readily be determined for various 20 materials by the skilled worker by simple experimentation. The duration of heating is preferably within the range from 0.5 to 3 h, particularly preferably within the range from 0.5 to 1.5 h. The heating temperature is preferably within a range 25 between the glass transition temperature and a temperature which is 5°C above the glass transition temperature. The heating temperature is particularly preferably within a range between 0.5 and 3°C above the glass transition temperature.

30

Once the heating temperature has been reached, the substrate and the covering present thereupon are preferably held for a particular period within the range of the heating temperature. This period is 35 preferably at least 15 min, particularly preferably at least 30 min, for example from 40 to 45 min. The holding temperature is preferably within approximately ±3°C of the heating temperature.

- 5 -

Step (d) of the novel process comprises the cooling. The cooling to about 40°C is preferably carried out slowly. The duration of the cooling is generally at least 1 h, particularly preferably at least 2 h and 5 most preferably up to 3.5 h. As an alternative, the cooling may also take place within a few seconds, e.g. up to 30 sec. After the cooling, the finished polymeric part can be removed.

10 The novel process gives adhesive-free bonding of polymeric coverings, preferably in the form of transparent films, and structured, preferably transparent, sheets of polymeric substrate. This bonding is mechanically and chemically stable. The 15 process can be carried out at relatively low temperatures in the vicinity of the glass transition temperature, preferably just above the glass transition temperature. No reaction products are produced, and the process is therefore extremely clean and biocompatible. 20 In particular, measurements show no reduced transparency and no increased fluorescence in the resultant component. If the covering materials and substrate materials are of the same type, the component produced is composed of just a single material and has 25 optical and electrical properties superior to those of multicomponent systems. The optical quality is so high that it is even possible to detect individual molecules in channels of the components with a good signal/noise ratio.

30

The present invention further provides a polymeric component with hollow structures present therein, the component being obtainable by the process described above. The hollow structures present in this polymeric 35 component are preferably closed channels, i.e. channels closed on their upward-facing sides, with a width or/and depth of from 10 nm to 2 mm, and the component differs from polymeric parts known from the prior art in that it is essentially or even completely free from

- 6 -

adhesives and from thermal reaction products in its interior, in particular in the region of the hollow structures. The novel polymeric part also has full-surface bonding in the region where the surfaces of 5 substrate and covering are in contact, so that no dead spaces are present in the region of the hollow structures. The novel polymeric part may be used for detection procedures, in particular in optical or/and electrical detection procedures.

10

The invention is further described by the examples below.

15

**Example 1 Production of a polymethyl methacrylate component**

20

A PMMA film is positioned on a surface of a PMMA substrate block, which surface has micro- or/and nanochannel structures. The surfaces of both parts are clean and smooth. The two parts are placed between two flat sheets of glass, which are then clamped into a press. The pressure applied in the press is within the range from 0.2 to 20 kg/cm<sup>2</sup>, e.g. 2 kg/cm<sup>2</sup>. The entire system is then slowly heated, preferably within a 25 heating time of from 0.5 to 1.5 h, in a controllable heating cabinet, to just above the glass transition temperature of the polymer. The glass transition temperature here depends on the heating rate. The ideal bonding temperature for the heating rate mentioned is 30 106 ± 0.5°C.

35

The system is then held for a period of from 40 to 45 min at a temperature between 104°C and the ideal bonding temperature. This is followed by slow cooling, preferably for ≤ 3.5 h. After the cooling, the finished structure can be removed from the apparatus. If desired, the cooling phase may also be considerably shortened, down to the seconds region.

## Example 2 Production of a polycarbonate component

5 Using the method described in Example 1, a polycarbonate component was produced. It was found here that this material, too, was suitable for producing components with closed micro- and nanochannel structures.

10

The bonding temperature was within the range from 150 to 160°C.

## Claims

1. A process for producing polymeric constituents, including the steps of:
    - 5 (a) preparing a polymeric substrate which has depressions on at least one surface,
    - (b) applying a polymeric covering to a surface present on the substrate and having depressions,
  - 10 (c) heating the substrate with the covering present thereupon to a temperature which is at least as high as the glass transition temperature of the substrate or/and of the covering, and
  - 15 (d) cooling.
2. The process as claimed in claim 1,  
**wherein**  
the polymeric substrate and the polymeric covering  
20 are selected from the group consisting of acrylic polymers, polycarbonates, polystyrenes, and also copolymers and mixtures of these.
3. The process as claimed in claim 2,  
25 **wherein**  
the polymeric substrate and the polymeric covering  
are selected from the group consisting of acrylic polymers, in particular of polymethyl methacrylate polymers, or of polymeric carbonates.
- 30 4. The process as claimed in any of claims 1 to 3,  
**wherein**  
the substrate has depressions with a width or/and depth within the range from 10 nm to 2 mm.
- 35 5. The process as claimed in claim 4,  
**wherein**  
the substrate has depressions with a width or/and depth within the range from 100 nm to 1 mm.

6. The process as claimed in claim 5,  
**wherein**  
the substrate has depressions with a width or/and  
5 depth within the range from 1  $\mu\text{m}$  to 500  $\mu\text{m}$ .
7. The process as claimed in any of the preceding  
claims,  
**wherein**  
10 substrate and covering are selected from among  
polymeric materials of the same type.
8. The process as claimed in any of the preceding  
claims,  
15 **wherein**  
at least the covering is selected from among  
optically transparent materials.
9. The process as claimed in any of the preceding  
20 claims,  
**wherein**  
the polymeric covering and the substrate are  
combined by pressure.
- 25 10. The process as claimed in claim 9,  
**wherein**  
the pressure applied is within the range from 1 to  
1000 kg/cm<sup>2</sup>.
- 30 11. The process as claimed in any of the preceding  
claims,  
**wherein**  
the duration of heating is within the range from  
0.5 to 3 h.
- 35 12. The process as claimed in any of the preceding  
claims,  
**wherein**

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the heating temperature is not more than 5°C above the glass transition temperature.

13. The process as claimed in any of the preceding  
5 claims,

**wherein**

the substrate and the covering present thereupon are held within the region of the heating temperature for a period of at least 15 min.

10

14. The process as claimed in claim 13,

**wherein**

the substrate and the covering present thereupon are held within the region of the heating temperature for a period of at least 30 min.

15

15. The process as claimed in claim 13 or 14,

**wherein**

20

the holding temperature is within  $\pm 3^\circ\text{C}$  of the heating temperature.

16. The process as claimed in any of the preceding claims,

**wherein**

25

the duration of the cooling is at least 1 h.

17. The process as claimed in claims 16,

**wherein**

the duration of the cooling is at least 2 h.

30

18. The process as claimed in any of claims 1 to 15,

**wherein**

the duration of the cooling is up to 30 sec.

35

19. A polymeric constituent with hollow structures present therein, obtainable by a process as claimed in any of claims 1 to 18.

20. A polymeric component as claimed in claim 19,

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- 11 -

**wherein**

the hollow structures comprise closed channels with a width or/and depth of from 10 nm to 10 mm.

- 5 21. A polymeric component as claimed in claim 19 or 20,

**wherein**

the interior of the component is free from adhesives.

10

22. The use of polymeric components as claimed in any of claims 19 to 21 in detection procedures, in particular in optical or/and electrical detection procedures.

15

CONFIDENTIAL

## Abstract

The invention relates to a process for producing polymeric components with hollow structures present therein, e.g. in the form of closed micro- or/and nanochannels, said process involving no use of adhesives. The invention further relates to the polymeric parts obtainable by the process and the use of these in detection procedures.

US

PTO/SB/01 (4-96)  
 Approved for use through 9/30/98 OMB 0651-0032

Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

Type a plus sign (+) inside this box →

## DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION

Declaration OR  Declaration  
Submitted Submitted after  
with Initial Filing Initial Filing

Attorney Docket Number	HUBR 1165
First Named Inventor	Stuke, et al.
COMPLETE IF KNOWN	
Application Number	09/647,207
Filing Date	Sept. 27, 2000
Group Art Unit	
Examiner Name	

As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

"Adhesive-free bonding of polymeric components to  
produce closed micro- and nanochannel structures"

(Title of the Invention)

the specification of which

is attached hereto

OR

was filed on (MM/DD/YYYY)

Apr 1, 1999

as United States Application Number or PCT International

Application Number

PCT/EP99/02238

and was amended on (MM/DD/YYYY)

(if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37 Code of Federal Regulations, §1.56.

I hereby claim foreign priority benefits under Title 35, United States Code §119 (a)-(d) or §365(b) of any foreign application(s) for patent or inventor's certificate, or §365 (a) of any PCT International application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT International application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached?
			YES	NO
198 15 632.4	Germany	Apr 7, 1998	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> XXX <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

Additional foreign application numbers are listed on a supplemental priority sheet attached hereto.

I hereby claim the benefit under Title 35, United States Code §119(e) of any United States provisional application(s) listed below.

Application Number(s)	Filing Date (MM/DD/YYYY)	<input type="checkbox"/> Additional provisional application numbers are listed on a supplemental priority sheet attached hereto.

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US

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## DECLARATION — Utility or Design Patent Application

I hereby claim the benefit under 35 U.S.C. 120 of any United States application(s), or 365(e) of any PCT International application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application.

U.S. Parent Application or PCT Parent Number	Parent Filing Date (MM/DD/YYYY)	Parent Patent Number (If applicable)

Additional U.S. or PCT international application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.  
As a named inventor, I hereby appoint the following registered practitioner(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:  Customer Number  →  Place Customer Number Bar Code Label here.  
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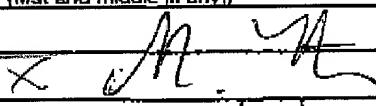
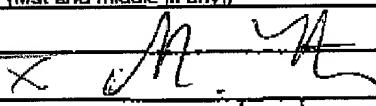
Name	Registration Number	Name	Registration Number

Additional registered practitioner(s) named on supplemental Registered Practitioner Information sheet PTO/SB/02C attached hereto.

Direct all correspondence to:  Customer Number or Bar Code Label  OR  Correspondence address below

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Name of Sole or First Inventor:	<input type="checkbox"/> A petition has been filed for this unsigned inventor				
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Additional inventors are being named on the supplemental Additional Inventor(s) sheet(s) PTO/SB/02A attached hereto

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DECLARATION				ADDITIONAL INVENTOR(S) Supplemental Sheet		
Name of Additional Joint Inventor, if any:				<input type="checkbox"/> A petition has been filed for this unsigned inventor		
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City		State	Zip	Country		
Name of Additional Joint Inventor, if any:	<input type="checkbox"/> A petition has been filed for this unsigned inventor					
Given Name		Middle Initial	Family Name		Suffix e.g. Jr.	
Inventor's Signature					Date	
Residence: City		State	Country		Citizenship	
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Post Office Address						
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<input type="checkbox"/> Additional inventors are being named on supplemental sheets attached hereto						

*Change of address done on 19.12.00*

*M. Miller*

(July 1996)